

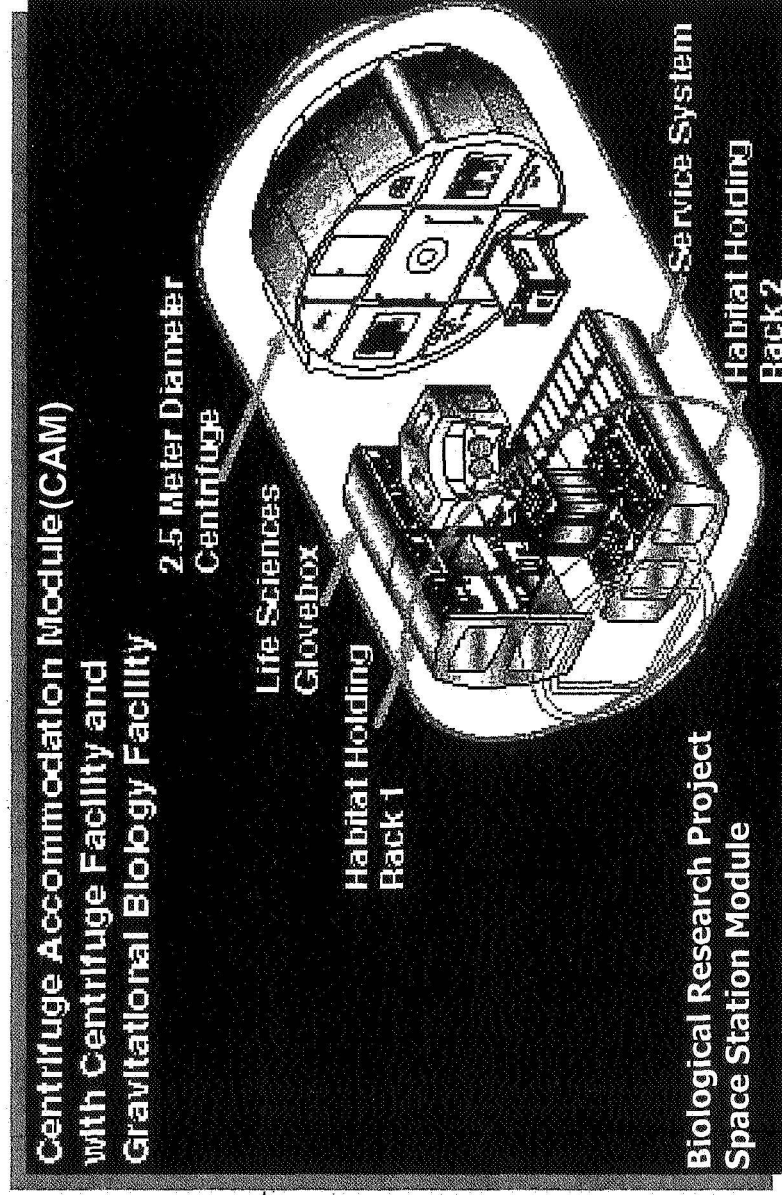
Implementing EVM Data Analysis

Adding Value from a NASA Project Manager's Perspective

Stacy M. Counts, Deputy Manager
Upper Stage Office, SE&I
NASA Marshall Space Flight Center

Data Analysis is one of the keys to an effective Earned Value Management (EVM) Process. Project Managers (PM) must continually evaluate data in assessing the health of their projects. Good analysis of data can assist PMs in making better decisions in managing projects. To better support our PMs, National Aeronautics and Space Administration (NASA) - Marshall Space Flight Center (MSFC) recently renewed its emphasis on sound EVM data analysis practices and processes. During this presentation we will discuss the approach that MSFC followed in implementing better data analysis across its Center. We will address our approach to effectively equip and support our projects in applying a sound data analysis process. In addition, the PM for the Space Station Biological Research Project will share her experiences of how effective data analysis can benefit a PM in the decision making process. The PM will discuss how the emphasis on data analysis has helped create a solid method for assessing the project's performance. Using data analysis successfully can be an effective and efficient tool in today's environment with increasing workloads and downsizing workforces.

Implementing EVM Data Analysis: Adding Value from a NASA Project Manager's Perspective



Jerald Kerby
NASA-MSFC
256-544-3243
gerald.g.kerby@nasa.gov

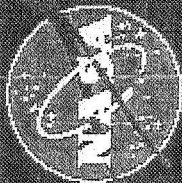
Stacy Counts
NASA-MSFC
256-544-6004
stacy.counts@msfc.nasa.gov

March, 2006

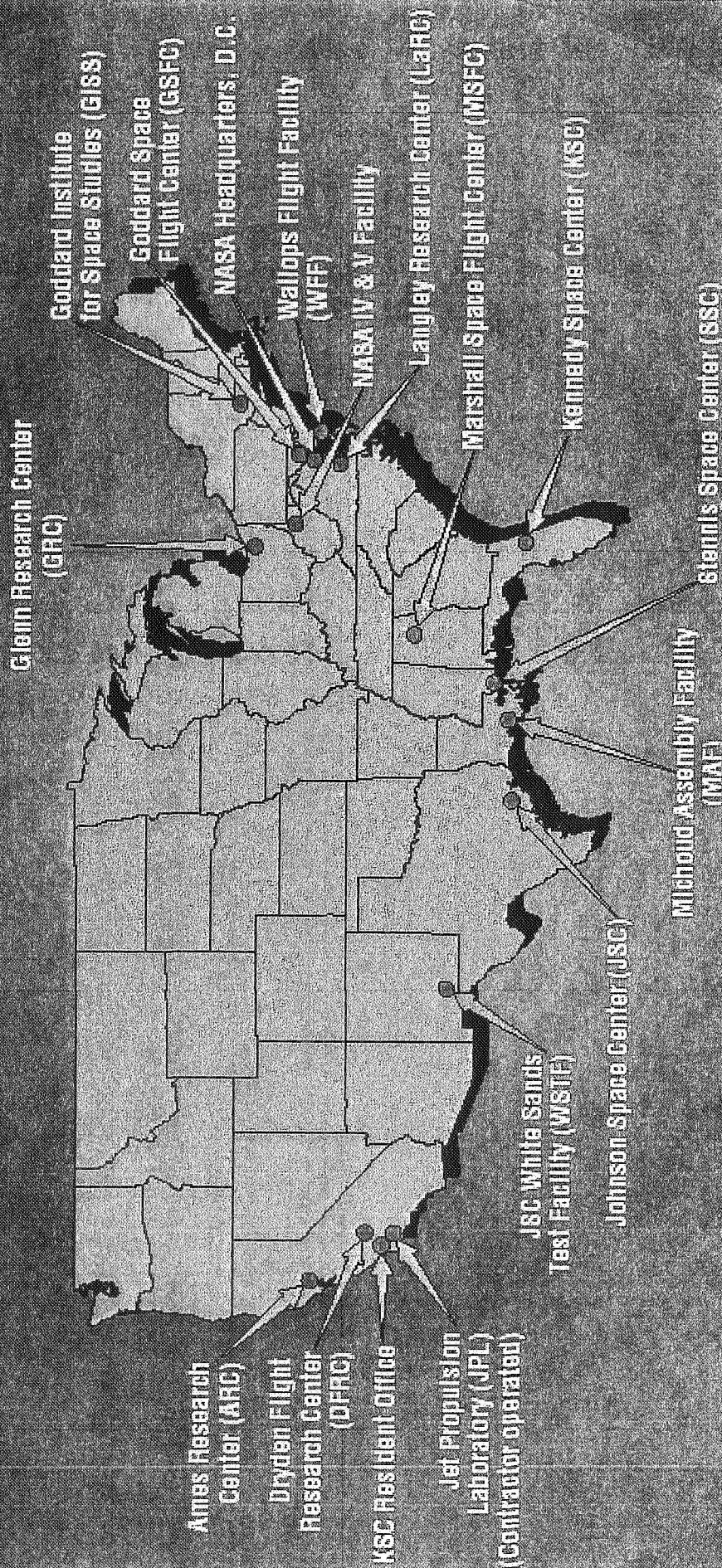
Outline

- ◆ NASA/MSFC Organizations
- ◆ Project Analysis Office Overview
- ◆ Data Analysis Implementation
- ◆ HHR Project Overview
- ◆ Standard Report
- ◆ Benefits to Project

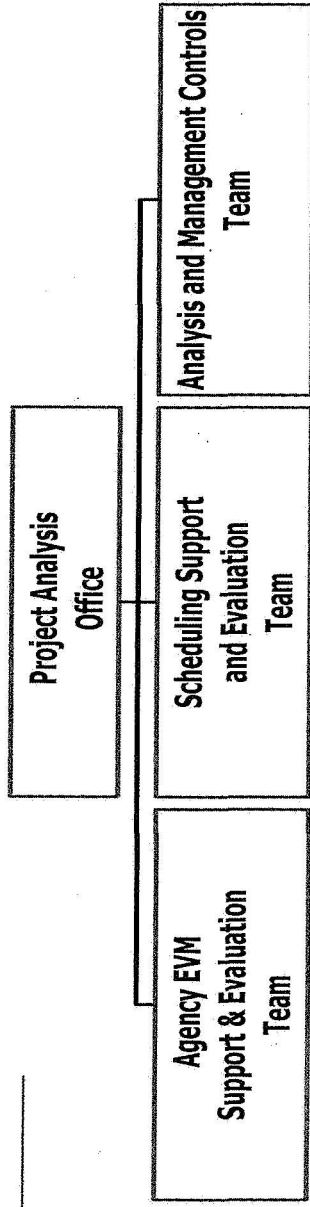




NASA Major and Component Installations



Project Analysis Office



◆ Diverse, complimentary skill mix

- EVM Analysts
- Schedule Analysts
- Accountants & Auditors
- Data Administrators Administrators
- Software Developers
- Engineers

Why Implement Data Analysis?



- ◆ Cancelled Projects
- ◆ Cost Control Team Recommendations
 - Need for better analytical tools
 - Need for better project analysis and data analysis
- ◆ MSFC Center Director's Cost Control White Paper
- ◆ Better Data Analysis will enable MSFC Programs/Projects increased insight into performance
- ◆ COLSA Recommendations – Habitat Holding Racks (HHR) Specific
- ◆ The President's Management Agenda – Fiscal Year 2002

Implementation Approach



◆ Three step approach

- Equip
 - ◆ Tools
 - ◆ System
 - ◆ Knowledge

Products

- wInsight
- Schedules
 - Filters
- Training - EV, wInsight, Schedule
- Policies, DRs, etc.

- Support
 - ◆ Standard Reports
 - 5 Pager
 - ◆ Training
 - ◆ Hands-on

- CPRs
- Training – EV, wInsight, Schedule, Data analysis, etc.
- Schedule Support

- Assess
 - ◆ Spot Check for Process Discipline
- Summary Reports

Biological Research Project (BRP)

Overview – Space Station Project



- ◆ The Biological Research Project (BRP) is an integrated project team, with the mission to design and develop the systems required to support a wide range of fundamental gravitational biology research on Space Station. BRP has worked with International Partners to develop the first space-based life sciences research facility. Facility capabilities include “artificial gravity”, life support and monitoring for animal, plant, and insect research subjects.
- ◆ Primary “host systems” are as follows:
 - Centrifuge – built by JAXA
 - Life Sciences Glovebox – built by JAXA
 - Habitat Holding Racks (HHR) – built by Boeing-HSV
 - ◆ Boeing via MSFC to design, build, test, and integrate the BRP Habitat Holding Racks and supporting systems utilizing the EXPRESS Rack as the design basis.
- ◆ Various animal and plant habitats as well as other life science experiments will be flown inside the host systems.

THE SPACE STATION

International Participation

Legend:

- United States
- Russia
- Japan (Kibo)
- Europe (COF)
- Canada (RMS)
- Italy (MPLM)
- Brazil (EXPRESS)

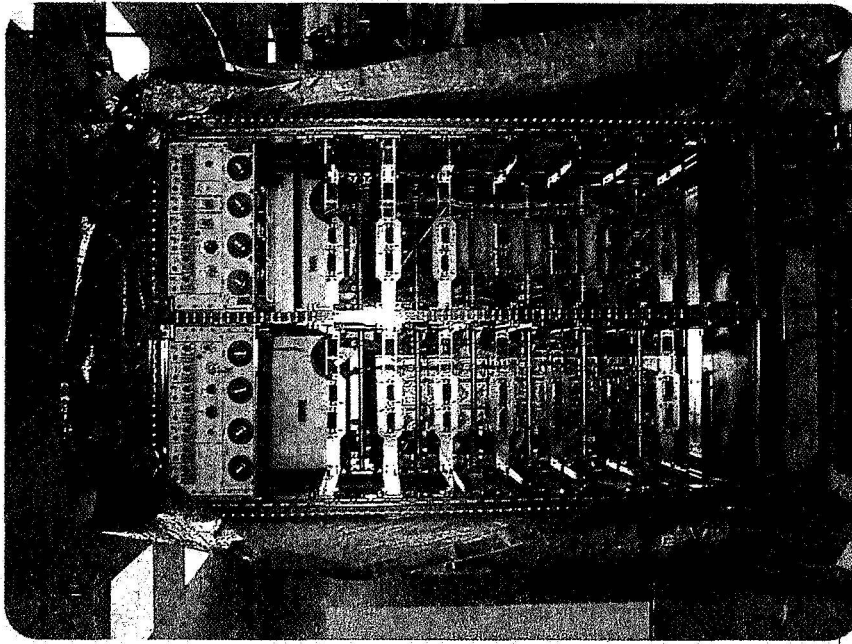
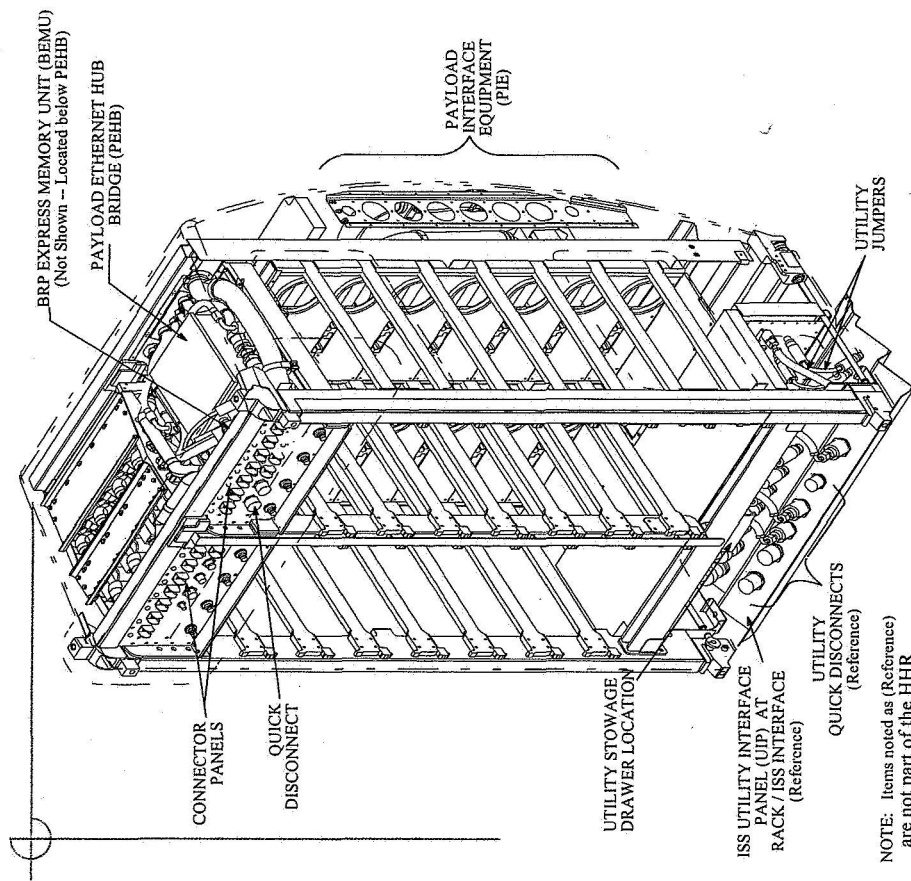
Station Components and Modules:

- Zarya (Sunrise) Control Module
- Service Module
- Docking Compartment
- Universal Docking Module
- Research Module
- Soyuz
- S6 Truss Segment
- S5 Truss Segment
- S4 Truss Segment
- S3 Truss Segment
- S1 Truss Segment
- S2 Truss Segment
- S3 Truss Segment
- S4 Truss Segment
- S5 Truss Segment
- S6 Truss Segment
- Solar Alpha Rotary Joint
- Thermal Control Panels
- Mobile Servicing System
- CSA Remote Manipulator System
- Centrifuge Accommodation Module
- JEM Experiment Logistics Module
- JEM Remote Manipulator System
- JEM Exposed Facility
- Japanese Experiment Module (JEM)
- Pressurized Mating Adapter 2
- Multi-Purpose Logistics Module
- Pressurized Mating Adapter 1
- European Lab. Columbus Orbital Facility
- Pressurized Mating Adapter 3
- Habitation Module
- Node 3
- Node 2
- Node 1
- Node 4
- Node 5
- Node 6
- Node 7
- Node 8
- Node 9
- Node 10
- Node 11
- Node 12
- Node 13
- Node 14
- Node 15
- Node 16
- Node 17
- Node 18
- Node 19
- Node 20
- Node 21
- Node 22
- Node 23
- Node 24
- Node 25
- Node 26
- Node 27
- Node 28
- Node 29
- Node 30
- Node 31
- Node 32
- Node 33
- Node 34
- Node 35
- Node 36
- Node 37
- Node 38
- Node 39
- Node 40
- Node 41
- Node 42
- Node 43
- Node 44
- Node 45
- Node 46
- Node 47
- Node 48
- Node 49
- Node 50
- Node 51
- Node 52
- Node 53
- Node 54
- Node 55
- Node 56
- Node 57
- Node 58
- Node 59
- Node 60
- Node 61
- Node 62
- Node 63
- Node 64
- Node 65
- Node 66
- Node 67
- Node 68
- Node 69
- Node 70
- Node 71
- Node 72
- Node 73
- Node 74
- Node 75
- Node 76
- Node 77
- Node 78
- Node 79
- Node 80
- Node 81
- Node 82
- Node 83
- Node 84
- Node 85
- Node 86
- Node 87
- Node 88
- Node 89
- Node 90
- Node 91
- Node 92
- Node 93
- Node 94
- Node 95
- Node 96
- Node 97
- Node 98
- Node 99
- Node 100

Figure 1. A schematic diagram of the experimental setup. The subject is seated in a chair, viewing a screen. The screen displays a target (a red dot) and a starting point (a green dot). The subject's hand is positioned at the starting point. The distance between the starting point and the target is labeled as d . The subject's hand is moved towards the target, and the distance between the hand and the target is labeled as x . The subject's hand is stopped at the target, and the distance between the hand and the target is labeled as x_f .



BRP - Habitat Holding Rack





BRP Habitats

- ◆ Advanced Animal Habitat
 - Research environment for laboratory mice and rats
- ◆ Aquatic Habitat
 - Research environment for small fresh water organisms
- ◆ Cell Culture Unit
 - Research environment for cell and tissue cultures
- ◆ Insect Habitat
- ◆ Avian Development Facility
 - Research environment for Japanese quail and domestic chicken eggs
- ◆ Plant Research Unit
 - For support of plant growth

SSBRP Science Objectives



◆ Perform research in gravitational biology on space station

- Understand how biological specimens respond and adapt to micro gravity over single and multiple generations.
- Determine effects of long-term fractional gravity on biological specimens
 - ◆ Learn how microgravity affects development, nervous system function, movement and behavior, growth, reproduction, aging, gene expression, and circadian rhythms.
- Investigate effects of long-term space flight on biological specimens.
- Perform long-duration studies of plant-growth to determine the affects of gravity on fundamental plant reproductive biology and development.

Likely Benefits To NASA



◆ Science Advances

- Determination of minimum gravity levels for normal biological function
- New developmental and evolutionary biology research capabilities in space
- Better understanding of gravity's impact on astronaut health and performance
- Enhanced international leadership in gravitational biology

◆ Technology Advances

- Miniaturized, high-reliability biosensors
- Advanced, wireless data collection
- Intelligent, automated data systems
- Advanced telescience for remote access by researchers
- Advanced plant growth techniques for space missions

Likely Benefits To Public



◆ Science Advances

- Better understanding and treatment of bone, muscle, and balance disorders
- Better understanding of optimal plant growth
- New educational and training opportunities for future scientists

◆ Technology Advances

- Advanced biomedical technologies
- Advanced agricultural techniques
- Cutting edge technologies for commercialization by U.S. industry
- Advanced telemedicine for remote access to health care

Biological Research Project Funding Profile



April 1996 Program Operating Plan (POP) Submit	\$X
April 1998 POP Submit	8% increase
November 2000	78% increase
September 2001 (reduced scope)	17% decrease
January 2002	9.6% increase
Present	11% increase

**Contract End/Flight Hardware delivery on October 31,
2004**

HHR Project Content History



END ITEMS	Remains	Deleted 1st Phase	Deleted 2nd Phase
Qualification Rack	1		
Flight Racks	2		
Suitcase Simulators	2		
Habitat Fluid Transfer System	3		
Closeout Covers	3		
Habitat Functional Simulator Suite	2 (one added in PCP 1186)		
Habitat Mass Simulator Complement	1 set		
Transportation Racks	2		
ARC Trainer	1		
JSC Trainer	1		
Habitat Checkout Units	4		
Rack Interface Support Equipment	1		
Spares	2 sets		
Portable User Operations Station	1		
Command/Telemetry Databases	1		

TASKS

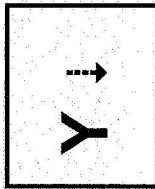
- Habitat Physical Integration
- Analytical Integration
- Integrated Rack KSC Support
- Passive Damping/Rack Isolation Analysis
- User Operations Facility Display Development
- Centrifuge/Glovebox Developer Support
- User Operations Facility Console Operations

Standard 5 Pager

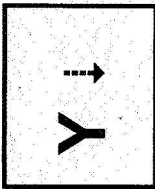
SAMPLE DATA



SCHEDULE PERFORMANCE



COST PERFORMANCE





TO MEET BUDGET AT COMPLETION (BAC)



TO MEET CONTRACTOR'S LATEST REVISED ESTIMATE (LRE)



Performance Indicator Key	At Completion Indicator Key
Worse than -10%	 $TCPI > CPI$ by more than 5%
Between -10% and -5%	 $TCPI > CPI$ by less than 5%
Better than -5%	$TCPI < CPI$
Change Threshold = 5%	

HHR Worse than - 5% = Red

EVM Implementation Process for HHR



- ◆ Mini-IBR (Integrated Baseline Review)
 - Audits across project functions
 - ◆ Resources
 - ◆ Schedule
- ◆ Re-established schedule for current environment and performance
- ◆ Adjusted EAC according to new schedule
- ◆ Monthly meetings with Contractor to review EVM data



EVM Quick-Look Report

SAMPLE DATA

Dollars in Thousands

Funding Status			
\$ \$ in Millions			
23.4			
20.8			
20.8			
22.0			
Project Funding			
LRE			
PMB			

Variance Status Indicator Key					
Worse than -10%		Better than -5%		Change Threshold = 5%	
Y	SG				
Between -10% and -5%					

\$\$ in Thousands	BCWS	BCWP	ACWP	Schedule Variance		Cost Variance	
Current Pd.	1,645	1,509	1,707	-136	Y ↓	-198	-13.1%
Cumulative	7,279	6,851	7,350	-428	Y ↓	-499	-7.3%

NASA		Ktr.	
BAC	20,796	↑	
EAC	22,480	↑	
VAC	35	↓	

EAC Forecast	Min.	Max
	22,022	23,385

Percent Scheduled	35.0 %
Percent Complete	32.9 %
Percent Spent	35.3 %

3 Mo. Avg Spend Rate	1,441	(7%)
6 Mo. Avg Spend Rate	1,067	(5%)

To Compl Perf Index (TCPI) BAC	1.04	↑
To Compl Perf Index (TCPI) LRE	1.04	↓

SPI	Current	0.92	↓
	Cumulative	0.94	↓
CPI	Current	0.88	↓
	Cumulative	0.93	↓
	3 Mo. Avg CPI	0.95	
	6 Mo. Avg CPI	0.92	



Top Issues Summary

Top Schedule Variances

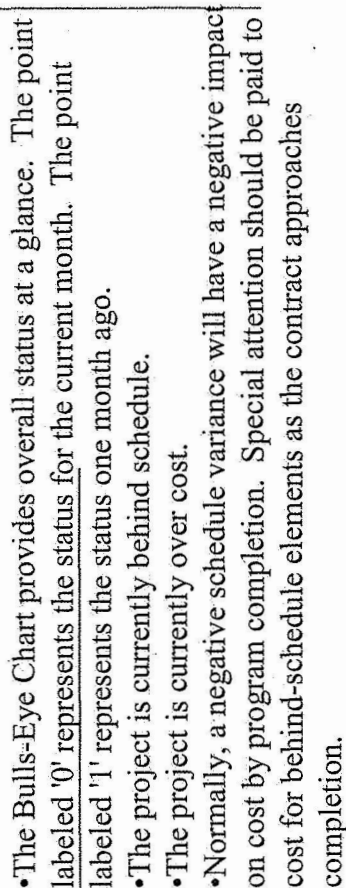
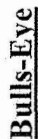
	WBS	Description	SV	CV	VAC	CPI	TCPI-LRE	CPI to LRE	SV	CV	BAC	LRE	% Budget
1	3200	COMMUNICATIONS				0.84	1.03	-0.19	(203)	(131)	2,043	2,130	9.8%
1	3700	DATA DISPLAY				1.00	1.00	0.00	(113)	0	388	388	1.9%
1	3300	AUX EQUIP				1.13	0.96	0.17	(93)	78	2,418	2,410	11.6%
1	3100	SENSORS	Y ↑			0.97	0.99	-0.02	(37)	(11)	1,728	1,750	8.3%
1	2100	PROJ MANAGEMENT		Y ↔		0.94	1.04	-0.10	(12)	(17)	618	622	3.0%

Top Cost Variances

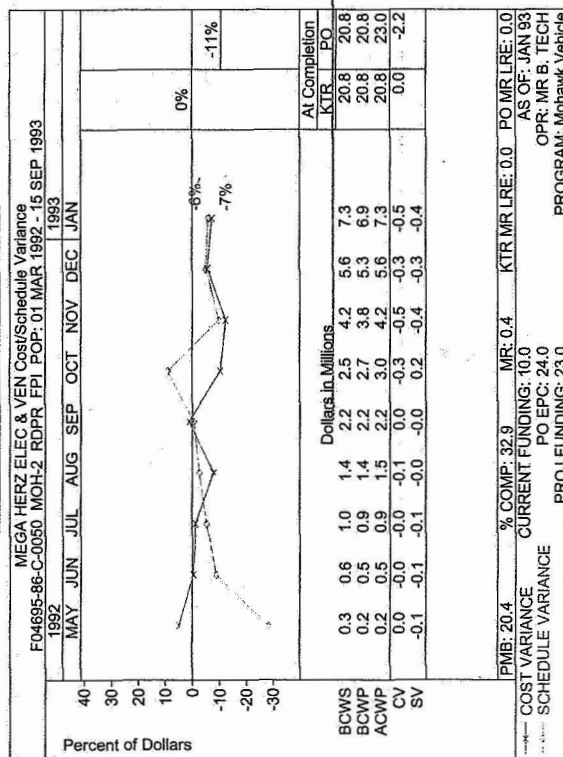
	WBS	Description	SV	CV	VAC	CPI	TCPI-LRE	CPI to LRE	SV	CV	BAC	LRE	% Budget
1	3600	PCC				0.85	1.03	-0.18	(11)	(296)	5,801	5,988	27.9%
2	3200	COMMUNICATIONS				0.84	1.03	-0.19	(203)	(131)	2,043	2,130	9.8%
3	2200	SYS ENGINEERING				0.90	2.65	-1.75	6	(26)	283	283	1.4%
4	3800	I & A				0.96	1.00	-0.05	83	(24)	1,440	1,465	6.9%
5	2100	PROJ MANAGEMENT		Y ↔		0.94	1.04	-0.10	(12)	(17)	618	622	3.0%

Top LRE Issues

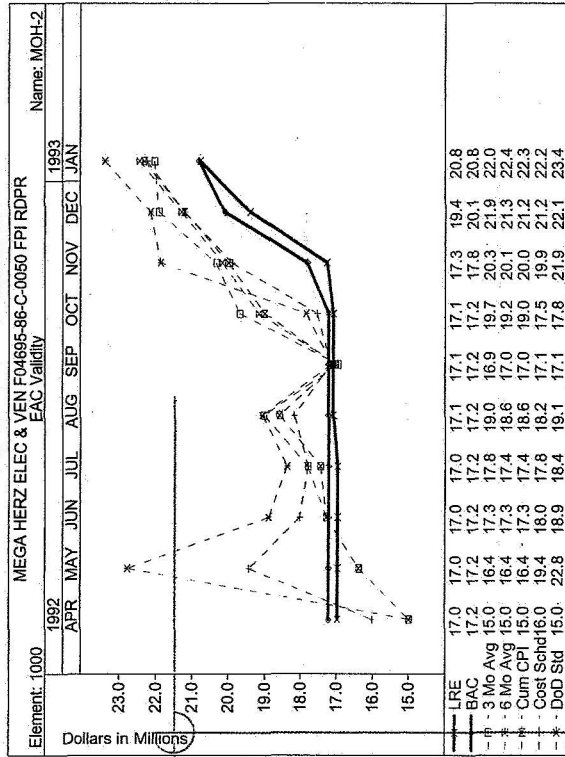
	WBS	Description	SV	CV	VAC	CPI	TCPI-LRE	CPI to LRE	SV	CV	BAC	LRE	% Budget
1	3600	PCC				0.85	1.03	-0.18	(11)	(296)	5,801	5,988	27.9%
2	3200	COMMUNICATIONS				0.84	1.03	-0.19	(203)	(131)	2,043	2,130	9.8%
3	4000	SPARES		Y ↑		0.95	1.00	-0.06	1	(8)	756	762	3.6%
4	2100	PROJ MANAGEMENT		Y ↔		0.94	1.04	-0.10	(12)	(17)	618	622	3.0%
5	2200	SYS ENGINEERING				0.90	2.65	-1.75	6	(26)	283	283	1.4%



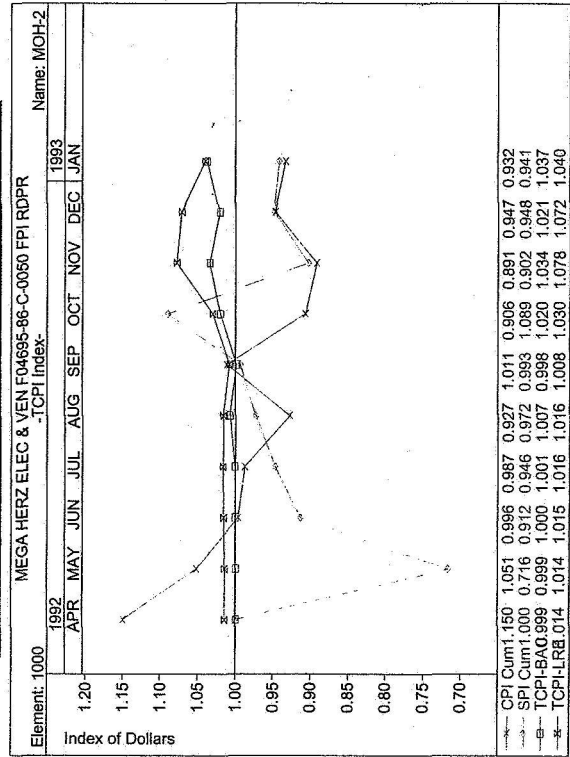
Cost/Schedule Variance



Estimate at Completion Validity



To Complete Performance Index (TCPI)



- The LRE Validity Chart compares the contractor's Latest Estimate (LRE) to several statistically derived values for the Estimate at Completion (EAC). The LRE and EAC are terms that are often used interchangeably, representing the estimate of the total direct charges against the contract. The LRE should be somewhere within the range of the calculated values.
- Currently, MEGA HERZ ELEC & VEN LRE of 20,761 is 35 less than the BAC
- The LRE appears to be below the range of the statistically derived values.
- "Since the LRE falls outside the range of calculated values, the contractor should re-evaluate the LRE as soon as possible."
- The To Complete Performance Index (TCPI) chart illustrates the efficiency rate that the contractor must accomplish to meet the BAC or LRE, based on the contractor's performance to date.
- To date, the cost performance efficiency has been 0.932. In other words, for each dollar spent, the contractor has accomplished \$0.93 worth of the work budgeted.
- To meet the BAC, the contractor must accomplish \$1.04 of work for each dollar spent.
- Given the performance to date, it does not seem likely that the contractor will be able to meet the BAC.
- To meet the LRE, the contractor must accomplish \$1.04 of work for each dollar spent.
- Given the performance to date, it does not seem likely that the contractor will be able to meet the LRE.

EVM Definitions

TERMINOLOGY

ACWP ACTUAL COST OF WORK PERFORMED (ACTUAL COST)
 BAC BUDGET AT COMPLETION (ALLOCATED BUDGETS)
 BCWP BUDGETED COST OF WORK PERFORMED (EARNED VALUE)
 BCWR BUDGETED COST OF WORK REMAINING
 BCWS BUDGETED COST OF WORK SCHEDULED (PLANNED VALUE)
 CBB CONTRACT BUDGET BASELINE (TOTAL AUTHORIZED WORK)
 CPI COST PERFORMANCE INDEX
 CV COST VARIANCE (BCWP-ACWP)
 EAC ESTIMATE AT COMPLETION (GOVERNMENT'S EAC)
 ETC ESTIMATE TO COMPLETE
 LRE LATEST REVISED ESTIMATE (CONTRACTOR'S EAC)
 MR MANAGEMENT RESERVE
 PMB PERFORMANCE MEASUREMENT BASELINE
 SPI SCHEDULE PERFORMANCE INDEX
 SV SCHEDULE VARIANCE (BCWP-BCWS)
 UB UNDISTRIBUTED BUDGET

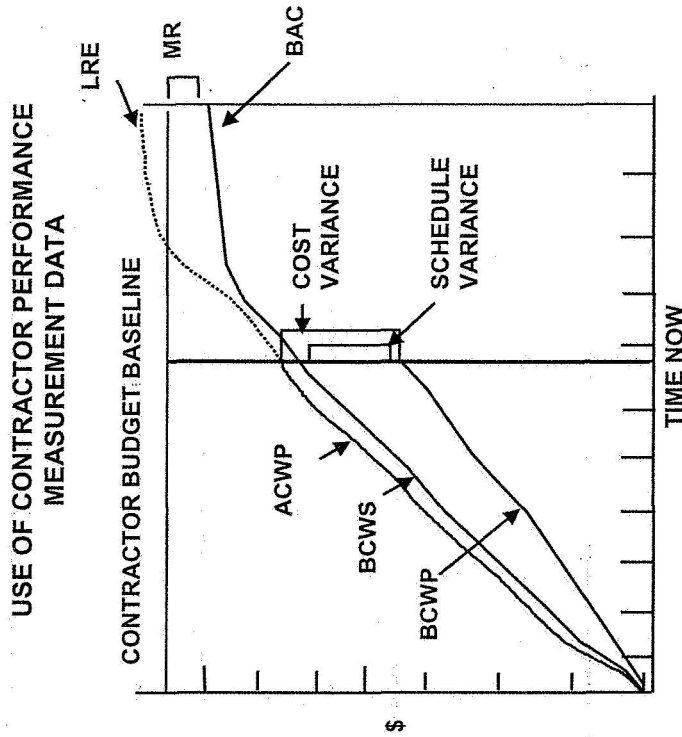
COMMON CAUSES FOR VARIANCE

FAVORABLE

POOR INITIAL PLANNING OR ESTIMATING
 TECHNICAL BREAK THROUGH
 COST OF LABOR AND MATERIAL LOWER THAN PLAN
 FRONT END LOADING
 METHOD OF EARNING BCWP

UNFAVORABLE

POOR INITIAL PLANNING OR ESTIMATING
 TECHNICAL PROBLEM
 COST OF LABOR OR MATERIAL HIGHER THAN PLAN
 INFLATION
 NEW LABOR CONTRACTS
 WORK STOPPAGE



CPR COST PERFORMANCE REPORT
 C/SSR COST/SCHEDULE STATUS REPORT

PURPOSE: TO OBTAIN CONTRACT COST AND
 SCHEDULE STATUS INFORMATION
 ON WHICH TO BASE PROGRAM
 MANAGEMENT DECISIONS

Benefits of EVM Data Analysis



◆ NO SURPRISES!

- ◆ EVM provides a more realistic approach to cost planning based on statistical data
- ◆ EVM provides a tool for Project Managers to utilize in reviewing Contractor data
 - Direct comparisons between contractor data and wInsight data is very beneficial
- ◆ Provides a solid means to forecast future cost requirements based on previous contractor performance
- ◆ Shows Valid History
 - Looks at both total contract and new baseline performance
- ◆ Provides estimate of required contractor performance to maintain budget within project schedule
 - Provides projections/justifications for future budgets
 - Provides good Estimates at Completion (EAC)
- ◆ Provides trends analysis to reflect whether contractor performance is decreasing or increasing
- ◆ Identifies Cost/Schedule drivers
- ◆ Helps determine risks to project
- ◆ Information to support hunches